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DIVISION 5
SUBGRADES, BASES, AND SHOULDERS

SECTION 500
FINE GRADING SUBGRADES, SHOULDERS AND DITCHES

500-1 DESCRIPTION

The work covered by this section involves the preparation, shaping, manipulation of moisture content, and compaction of either an unstabilized or stabilized roadbed to a condition suitable for placement of base course, pavement, and shoulders. By definition of Article 101, the roadbed is the graded portion of a highway from ditch to ditch in cuts and shoulder point to shoulder point in fills. This section requires the Contractor to prepare and shape the subgrade; clean, shape, and maintain roadway ditches; strip the existing vegetation, and place and compact in accordance with Sections 235 and 560 material resulting from the shaping operations. This section shall only be applicable on those portions of the project, which will be paved under the contract.

On any project or portion of a project where **grading** is the only work to be performed under the terms of the contract (no base or pavement to be placed), the requirements of this section are **not** applicable. Such work shall be covered under the provisions of Section 225-3, Unclassified Excavation, or Section 230, Borrow Excavation, depending upon the source of material. Therefore, this provision will only apply to turnkey projects (where the fills have been built during the same contract that requires fine grading and paving) and paving projects.

When a project graded under a previous contract is to be paved under a second contract, the Engineer should, determine the profile elevation of the existing grade along both edges and the centerline of the future pavement before the Contractor begins work. All vertical clearances for overhead structures shall be checked and recorded and the vertical tie-in alignment to structures shall be checked to eliminate any possible grade differences. If a grade revision appears necessary and feasible, the Engineer should consult with the Division Engineer before making any revision. Before making a revision, several things must be considered. The vertical clearances at overhead structures and tie-ins to structures must be checked. A minimum of 200 feet should be utilized to make the transition to the new grade at each end of any adjustment.

If proposed grade requires the Contractor to excavate more than 0.4 foot below an existing graded surface, the excavation below 0.4 foot must be paid for as unclassified excavation. Refer to Article 500-5 of the Specifications. On those projects or portions of a project which will be paved under the contract (such as turnkey projects), the Engineer shall consider the above vertical clearance and tie-ins prior to establishing the subgrade elevations. In addition, the Engineer must consider the type of equipment to be used by the Contractor to cut this grade. Automatically controlled fine grade equipment may require approximately 1 inch of cut material in order to function effectively. All records relative to the above adjustment must be retained until the project is complete and the final estimate has been paid.

Also, before any work is begun by the Contractor, the Engineer in accordance with Article 104-10 of the Specifications, should set up an inspection of all existing drainage facilities and structures and record their condition prior to beginning work. The description of the condition of drainage facilities should include any previous damage and the degree of filling by silt or sand in existence at the time of the inspection. A representative of the Contractor should be given an invitation in writing to be present during this inspection. The inspection should be held on the date of availability or the day the Contractor begins work, whichever occurs first.

500-2 CONSTRUCTION METHODS

(A) GENERAL

Material generated from fine grading shall be utilized to the fullest extent possible. There will be no compensation for the direct utilization, other than completion of the unclassified excavation, or stockpiling and hauling of the material generated from fine grading. It is the responsibility of the Contractor to balance the suitable excavation throughout the limits of the project.

On projects or portions of projects where the grading was completed under a previous contract, suitable material excavated below a level of 0.4 foot below the existing graded roadbed and above subgrade is considered as unclassified excavation and is to be utilized in fine grading, earth shoulder construction, or in any other work requiring the utilization of suitable material. Any surplus material upon completion of this work shall be disposed of by the Contractor, in accordance with Article 802.

On turnkey projects the provision concerning 0.4 foot below the existing graded roadbed and above subgrade does not apply (see paragraph 3 of Section 500-5).

The Contractor shall conduct his operations in such a manner as to avoid damage to any previously constructed structures and facilities. By conducting an inspection of drainage facilities and structures early in the project, as outlined in Article 500-1 herein, the Engineer will be able to determine if the damage occurred during the life of the project or is a pre-existing condition.

(B) PREPARATION OF SUBGRADE

The Contractor may utilize any method or equipment he desires in preparing the subgrade when the Special Provisions do not require the use of an automatically controlled fine grade machine and when pavement is to be constructed.

When conventional methods and equipment such as self-loading scrapers and motor graders are utilized by the Contractor, it may be necessary to scarify or plow the subgrade to a depth of 3 to 4 inches before shaping and compaction are begun in order to break up slippage planes in the subgrade material and to provide a surface in which the moisture content may be more readily controlled in the event that it is necessary to add moisture or dry the material to obtain the required density.

When an automatically controlled fine grade machine is utilized by the Contractor, the anticipated benefit is a more uniform subgrade finish with less equipment and less effort. However, the use of this equipment does not eliminate the necessity for scarifying, plowing, and wetting or drying.

The Engineer and Technician do not have the authority to direct the Contractor to change his methods inasmuch as this is an end result Specification. However, if the methods employed do not produce an acceptable subgrade, density and surface they do have the right to offer suggestions as to how the required end product might be achieved. See Article 108-5 of the Specifications and this Manual.

Project personnel should, wherever possible, be on the lookout ahead of the finish fine grade operations for areas of unsuitable material, areas requiring underdrain, and areas requiring chemical or aggregate stabilization. These areas should be promptly investigated and decisions rendered as expeditiously as possible. Prompt action in these matters will allow the Contractor to organize his work schedule such that unnecessary delays will be avoided. Whenever possible, decisions on these matters should be made by the Engineer, or if the authority is delegated, the

project Technician. If assistance is needed, the Engineer should contact the Division Engineer, Roadway Construction Engineer, or the Geotechnical Engineering Unit.

Any surplus material generated in the preparation of a subgrade and not needed in the immediate adjacent areas of subgrade being prepared may be stored or stockpiled by the Contractor. This material is considered as unclassified excavation and should be utilized as such in the remaining phases of project construction. This applies only to previously graded projects and does not apply to turnkey projects. The Engineer should discuss the location of stockpiles with the Contractor and determine that proposed locations do not interfere with proper drainage or any subsequent operations of stabilization, placing base, or placing pavement. Since the cost of repair seeding and mulching made necessary as a result of stockpiling is normally borne by the Department, the Engineer should not permit the Contractor to stockpile material at such locations and in such manner as to cause any greater damage to the seeding and mulching than is absolutely necessary. Any surplus material remaining in the stockpiles is to be disposed of by the Contractor in accordance with the provisions of Article 225-3.

On projects where the Contractor is required to grade the project, place base and pavement, and construct earth shoulders, the Contractor may leave the grade high prior to subgrade preparation by an amount sufficient to produce the majority of the earth shoulder material by trenching and windrowing the earth material from the subgrade to the shoulder area. In this type of operation, adequate drainage of the subgrade shall be maintained by the Contractor at all times and the provisions of Article 500-4 of the Specifications will apply. In accordance with Article 560-4, no direct payment will be made for shoulder construction utilizing this method. Additional material, if needed, shall be obtained from roadway excavation or borrow sources and shall be paid for accordingly.

When an automatically controlled fine grade machine is utilized by the Contractor and the machine is of the type which is capable of placing surplus material directly into the earth shoulder construction area, such methods are permissible provided the Contractor keeps the subgrade adequately drained. In accordance with Article 560-4, no direct payment will be made for shoulder construction utilizing this method. Additional material, if needed, shall be obtained from roadway excavation or borrow sources and shall be paid for accordingly.

(C) COMPACTION OF SUBGRADE

If possible, before beginning compactive efforts, a decision should be made whether stabilization by external means will be required. Stabilization is normally performed with aggregate and/or chemicals. In compacting a subgrade, the work necessary to obtain the required density is directly related to the type of soil, the proper control of moisture in the soil and the equipment and methods used in the work. The Density Technician should work closely with the Contractor's supervisory personnel in determining the moisture content of the soil at which the required density can best be obtained. Optimum moisture as determined by moisture density curves is, of course, the ideal; but the range above or below optimum moisture in which the required density can be obtained with a reasonable effort is extremely variable. Article 500-2(C) of the Specifications requires the Contractor to "dry or add moisture to the subgrade when required." This article places the burden of when and how much upon the Contractor. The Technician or Engineer should consult with the Contractor in this matter and furnish information based upon results of testing performed, but should not direct the Contractor's operations relative to the moisture content at which the Contractor attempts to compact the subgrade. Should the Contractor attempt to obtain compaction when the moisture content of the soil is not within the range determined to be reasonable for satisfactory compaction by the Technician or Engineer, the

Contractor should be so informed and the conditions should be fully documented in the project diary.

It should be further noted that “a uniformly compacted and acceptable subgrade” also indicates that the completed subgrade is to be uniformly stable and free of soft wet areas that weave or rut under traffic.

500-3 TOLERANCES

The established grade is the finished subgrade elevation as set by the Engineer. A tolerance of plus or minus $\frac{1}{2}$ inch of this elevation is allowed. Subgrade tolerance of plus or minus $\frac{1}{4}$ inch from the established grade is required for subgrade under concrete pavement mainline lanes. **Moreover, the maximum difference between the established grade and the graded subgrade within any 100 foot section longitudinally is $\frac{1}{2}$ inch and $\frac{1}{4}$ inch for subgrade for concrete pavements..** This holds true for each transverse point checked, i.e., centerline, edge of travelway, edge of pavement, etc.

For Example: At Station 0+00 the centerline grade checked $+\frac{1}{2}$ inch and at Station 0+30 (Station 1+00) the centerline checked $-\frac{1}{2}$ inch. Although each point individually is within $\frac{1}{2}$ inch of the established grade, this section would not be in tolerance since the **overall** difference is 1” which is greater than $\frac{1}{2}$ inch. The tolerance permitted by Article 500-3 of the Specifications is intended to give a reasonable amount of tolerance in the vertical control as long as such tolerance results in a reasonably uniform riding surface. Short dips or humps and warped cross section shall be avoided especially in vertical curves, horizontal curves, and superelevation runoffs.

When the Technician is informed by the Contractor that a section of subgrade is completed to line and grade, the Technician or the field party should check and record the finished elevation of the subgrade at intervals of 50 feet or less longitudinally and transversely at the centerline (if a crown section), at the edge of each travel lane [usually every 11-12 feet], and at each edge of pavement line. The record of subgrade elevation may be made either by utilizing the blue tops and a string line or with a level and should be recorded in accordance with the Records and Reports Section of this Manual.

Upon completion of the check of grade and cross section conformity, the Contractor is to be informed of any necessary corrections. Upon completion of any necessary corrections and verifications that density is acceptable, the Contractor should be advised that, barring damage before base or pavement is placed, the section of subgrade is approved for placement of base material.

500-4 MAINTENANCE OF SUBGRADE

Continuous maintenance of surface drainage is an absolute necessity in order to avoid soft areas that may develop due to the subgrade holding water for long periods of time. This requires the Technician to be on the alert for stopped-up drainage and depressed areas in the grade. These conditions should be immediately brought to the attention of the Contractor's Superintendent and corrected.

Neither should the subgrade be allowed to become dry to the extent that binder material is lost through dust. The Contractor shall be required to maintain the subgrade in a moist consolidated condition ahead of the base course operations.

Maintenance of the subgrade also requires the exclusion of hauling equipment, which causes rutting, weaving, or other distortion of the grade. Careful attention should be given to

windrowed material on shoulders to assure that drainage outlets are provided through the windrowed material so as not to hold water on a subgrade.

Refer to Article 104-10 of the Specifications, and this Manual for guidelines in implementing these provisions.

500-5 MEASUREMENT AND PAYMENT

The work of fine grading covered by this section is paid for on a lump sum basis and no actual measurement is required. The project records must verify that the density and surface finish were acceptable. The project diary should document the Contractor's election to utilize construction methods which result in no payment for shoulder borrow as provided for in Article 560-4 of the Specifications (Ex: trenching and windrowing earth material from the subgrade to the shoulder area).

In addition, cross sections must be entered in a pay record book to document any material removed from a level of 0.4 foot below the level of the existing graded surface for which the Contractor is to be paid as unclassified excavation. This provision does not apply to turnkey projects.

TECHNICIAN'S CHECKLIST
SECTION 500
FINE GRADING SUBGRADES, SHOULDERS AND DITCHES

1. Study Specifications, plans, and Special Provisions.
2. Remove any unsuitable material and replace. Keep appropriate pay records of quantities involved.
3. Promptly inspect and investigate any soft or yielding areas. Promptly investigate for necessity for underdrains and/or stabilization. Record results of all investigations.
4. Consult with Contractor and advise of optimum moisture for compaction.
5. Maintain adequate drainage of the subgrade at all times.
6. Run density tests and check tests as required by a certified density Technician. See that stability is obtained as well as density.
7. Check finished sections for line, grade and typical section, and record results. Advise Contractor of any areas needing correction.
8. See that any grade adjustment authorized is recorded and passed on to Technicians on subsequent operations (stabilization, paving, etc.).
9. Be familiar with any grade adjustments made by Engineer.
10. Keep complete and accurate pay records of any material removed 0.4 foot below the level of the existing roadbed. This applies only to a paving project following a previous grading project. This is paid for as unclassified excavation.
11. See that no excavated material that is suitable for use is wasted until all grading and shoulder construction are completed. If material is wasted prematurely, measure this material and make the appropriate deductions as outlined in Article 225-3.
12. Make certain that any equipment required by the contract is utilized.
13. Record in diary all conversations, observations, spot checks made, and work performed.

SECTION 501 LIME TREATED SOIL

501-1 DESCRIPTION

The work covered by this section consists of the construction of a satisfactory embankment or subgrade from an inferior quality earth material by adding and mixing a controlled amount of lime and water to give the embankment or subgrade material a greater stability. Locations are to be as noted in plans or as determined by the Engineer. Lime is not compatible with all types of soils; therefore, technical assistance should be requested from the Geopavement Section of the Geotechnical Engineering Unit, which will determine applicability and rates.

It should be remembered that a complete chemical stabilization investigation and rate determination generally takes 24 days to complete. The Engineer should anticipate this time requirement and notify the Geopavement Section accordingly.

501-2 MATERIALS

A ½ gallon sample of hydrated or quicklime should be obtained at a minimum frequency of one sample per day, provided the lime placed that day is from the same lot. The sample must be obtained from the discharge line, never from the ground after spreading. The lime sample must be transported to Materials & Tests Unit's Chemical Lab in a sealed doubled plastic bag (3 lb. sample) or a ½ gallon sealed plastic container to prevent damage and the intrusion of moisture. The Contractor must furnish Type 1 or Type 2 material certifications with each shipment of lime in accordance with Article 1052-3. The material is subject to inspection, testing, or rejection by the Engineer at any time.

501-3 LIMITATIONS

Lime stabilization is relatively slow setting and requires some warm weather to condition the soil. Construction should not be permitted in cold weather when air temperature is below 45 degrees F. Calendar restrictions have been removed.

Should it become necessary for the satisfactory and timely completion of the project to place lime outside the seasonal limitations outlined in Article 501-3 of the Standard Specifications, approval should only be given on a day by day basis. The Engineer should consult with the Construction Unit prior to granting such approval. This approval should only be granted on those days the Engineer is reasonably assured the sustained air temperature during the time of completion will remain above that required by the Standard Specifications. The Contractor must clearly understand that even if we allow the placement outside the seasonal limitations, he is still totally responsible for the quality.

The Engineer should monitor the Contractor's rate of progress to ensure that all lime treated soil is covered with a layer of pavement or base by December 1 of that same calendar year, as required by the Standard Specifications. In the event the lime treated soil is not covered, the Contractor must place a sand seal at his expense. This seal does not relieve the Contractor of the responsibility for any damage no matter what the cause.

501-4 EQUIPMENT

(A) GENERAL

The Engineer should inspect and approve all equipment to be used in the liming operation before the Contractor begins construction. Comply with Article 107-22.

(B) LIME SPREADERS

1. Lime Slurry is generally spread by Contractor tanker trucks equipped with pipe bars across the back. Holes approximately $\frac{3}{4}$ inch in diameter along the bottom of the bar allow a uniform flow of slurry from the tank of the truck to the roadway. These tanker trucks must be equipped to provide continuous agitation of the slurry from the slaking operation to the roadway. See Section 501-8 (B) of the Standard Specifications.
2. Quicklime may be applied by the transport tanker directly to the roadway. This is done by slowly driving the tanker truck over the coverage area with one or more of the bottom discharge valves open, creating windrows of lime. The windrows of lime are then evenly spread over the coverage area with a motor grader. See Article 501-8 (C) of the Standard Specifications. Quicklime may also be applied by transport tanker by slowly driving the tanker truck over the coverage area while blowing the lime out of the rear discharge valve into a pipe bar across the back. Holes along the bottom of the bar should provide a uniform flow of lime to the roadway.
3. Hydrated lime is generally applied by the transport tanker directly to the roadway. This is done by slowly driving the tanker truck over the coverage area while blowing the lime out of the rear discharge valve into a triangle deflector which directs the lime down on the roadway. This method of application is extremely dusty and is seldom used. See Article 501-8 (D) of the Standard Specifications.

(C) WATER DISTRIBUTION EQUIPMENT

Water is generally distributed by tanker trucks equipped with a pressure distributor or other suitable equipment capable of uniformly distributing the required amount. Tanker trucks should be free of fuel and water leaks to prevent creating saturated areas.

(D) MIXERS

Two mixers are needed for good production, and it is desirable that one of these be equipped with spray bars and water tanker hookup for adding water to the lime-soil. Mixing equipment must be capable of mixing to a compacted depth of 10 inches.

(E) COMPACTION EQUIPMENT

A roller or other comparable equipment should be used for obtaining full-depth compaction. However, final rolling of the completed surface will be done with a pneumatic tire roller or steel wheel roller. All compaction equipment shall be self-propelled.

(F) SCARIFYING EQUIPMENT

Approved equipment typically consists of a motor grader equipped with scarifying teeth able to partially pulverize soil to the full depth of the stabilized treatment

501-5 PROTECTION AND SAFETY

Lime Safety Precautions

Hydrated lime, like most chemicals in common use, is not dangerous to work with as long as some simple precautions are followed. Quicklime is considerably more dangerous to use than hydrated lime. Quicklime is much more caustic than hydrated lime and can produce severe burns quickly when in contact with moist skin. Prolonged contact of hydrated lime with a perspiring worker's skin where the skin is also chafed by tight clothing may produce burns. Persons with particularly sensitive skin may develop forms of skin irritation through prolonged contact.

If the following recommendations are followed, there is less possibility of burns or skin irritation to workers.

Clothing

1. Wear at least one long-sleeved shirt. Rolled-up sleeves or short-sleeved shirts should not be permitted.
2. Wear high top shoes or laced boots.
3. Wear trouser legs tied over shoe tops (shorts should not be permitted).
4. Wear hat or cap to protect scalp from accumulated lime dust.
5. Wear gauntlet-type gloves.
6. Do not wear clothes that bind too tightly around neck or wrists.

Eye Protection

Wear safety glasses with side shields or goggles **at all times** while working with lime.

Mouth and Nose Protection

When construction conditions are quite dusty, a lightweight filter mask should be worn although inhalation of some minor amounts of lime dust is not injurious.

After Work

Bathe or shower after a workday to cleanse the body entirely of lime.

First Aid

1. Skin Burns - Wash thoroughly with soap and warm water to remove all lime. Apply a standard burn ointment used for heat or caustic burns and cover with sterile bandages. Keep bandaged during healing to prevent infection.
2. Lime in the Eyes - Hold worker's eyes open and **flush** out with water **immediately**. Wash thoroughly with plenty of water.
3. Report all burns from lime or cases of lime in eyes **immediately** so that medical attention can be provided without delay.

501-6 PREPARATION OF ROADBED

Areas that are exceptionally unstable as compared to the prevailing project conditions must be corrected before processing starts. When deep unstable areas are encountered, it is usually necessary to remove the underlying soil by undercutting and replacing it with acceptable material. The Engineer should consult with the Roadway Construction Engineer and/or Geopavement Section in determining the depth of undercut.

The grade at the start of construction will influence the final cross section. Before any processing is started, the roadway should be shaped to approximate section and grade See Article 501-8(a) of the Specifications and of this Manual. Maintenance of the proper section will permit rapid runoff of water during heavy rains and aid in preventing wet spots.

501-7 SCARIFYING

The Contractor is required to scarify the roadbed prior to the application of lime using the appropriate equipment as listed in Article 501-4(F) of the Standard Specifications. Followed by this initial scarification, the roadbed is to be partially pulverized by making one pass with a rotary mixer. Should the soil type be of such that the initial scarifying sufficiently pulverizes the material, the rotary mixer may be deleted in this process. When the “Bottom Dump” method of lime application is to be used, scarification of the subgrade will be deleted. A smooth surface is necessary to ensure a uniform spread of the lime.

501-8 APPLICATION OF LIME

(A) GENERAL

When the area is ready for stabilization, it is recommended that the subgrade be no higher than the required grade and consideration be given to the bulking (swelling) of soil due to the addition of lime. Adjustment of subgrade may be necessary to prevent excessive waste during final grading. Best results occur when subgrade ranges from $\frac{1}{4}$ inch to $\frac{1}{2}$ inch below design subgrade elevation. However, it is the Contractor’s responsibility to make this determination.

Lime or lime slurry shall be spread only on an area of such size that all primary mixing operations can be completed in the same day during daylight hours except where the work is to be done at night as required by the contract.

501-9 MIXING

(A) PRIMARY MIXING

Primary mixing is required to distribute the lime uniformly throughout the soil to the proper depth and width and to pulverize the soil to a maximum of 2 inches in size. During this step, water is usually added to raise the moisture of the soil-lime mixture above optimum. The Standard Specifications allow a tolerance of 3% above optimum. The amount of water used during mixing is critical for proper slaking of the lime (produce a lime slurry). If the lime is not slaked well and moisture comes in contact with the lime, the lime will go through a process of expansion which can result in “blow out” spots. This can lead to rutting of the pavement structure. When the lime is mixed with water in agitating equipment (slurry method), this is rarely a concern. However, when lime is spread onto the soil first and water is added to slake the lime prior to mixing, this is a concern.

Rotary mixing of the lime, soil, and water will be required. After the initial mixing, the layer must be shaped to approximate section and compacted lightly in order to minimize evaporation loss or to prevent excessive wetting from possible heavy rains. Proper drainage is very important.

(B) PRELIMINARY CURING

The lime-soil mixture should cure for one to four days to permit the lime and water to break down the clay clods. As a general rule, soils with high clay content require more cure time. The surface of the material must be kept moist during this time to prevent drying.

(C) FINAL MIXING AND PULVERIZING

Mixing and pulverization should continue until all of the clods are broken down to no larger than ½ inch and at least 80% will be smaller than 4.75 millimeters (#4 sieve), exclusive of rock. It is important that mixing be thorough and rotary mixing is mandatory.

501-10 COMPACTING, SHAPING, AND FINISHING

Proper moisture content is important during compaction. The density value should be based on a representative field sample of the lime-soil mixture, not on the untreated (raw) soil. A light pneumatic roller should not be permitted to compact an entire layer in one lift. A pneumatic roller of sufficient weight to compact the entire layer in one lift shall be used. Lightweight equipment may tend to compact the top of the layer that will bridge the lower part and not obtain full compaction throughout the layer.

501-11 THICKNESS

The compacted lime thickness is to be determined and recorded by the Technician by measurements made in test holes located at random intervals not to exceed 500 feet. To insure that final compacted depths are correct, they should be checked, utilizing the string line from hub to hub during initial mixing and during final mixing. The measured thickness shall be no greater than plus 1 inch or minus ½ inch of the thickness established on the plans or by the Engineer.

A noticeable change in color and/or texture can be observed between treated and non-treated soil. If the lime thickness is not within the above described limits, refer to Section 501-11 of the Standard Specifications for corrective measures.

501-12 FINAL CURING

Curing of lime treated soil utilizes membrane **curing** which involves sealing the compacted layer with a bituminous curing seal. See Section 543 of the Standard Specifications and this Manual. Particular attention should be given to the rate of application to insure that the layer is fully covered, but not so much that the asphalt runs off excessively. A seven day curing period is required.

501-13 TRAFFIC

The stabilized area will be closed to all traffic during the curing period, except for local lightweight traffic. Areas of roadway which have to be utilized by local lightweight traffic should be covered with sand at the rate of 10 pounds per square yard, or other material which has been approved by the Engineer.

Construction equipment shall not use stabilized areas for haul roads, except to discharge material into a spreader during base construction or paving operations. The heavy loads imposed by hauling and paving equipment may create a major problem in some stabilized layers. The wheel loads from this equipment will produce higher stresses in the stabilized soils than the stresses to be anticipated from traffic loads after the road is in service.

501-14 MAINTENANCE

The stabilized area will be protected from freezing and maintained by the Contractor until a layer of pavement has been placed over it. Any maintenance or repair necessary will be performed by the Contractor at no cost to the Department and shall be repeated as often as may be necessary to keep the stabilized soil in an acceptable condition until all work is completed and accepted.

TECHNICIAN'S CHECKLIST
SECTION 501
LIME TREATED SOIL

Field inspection of lime-soil construction involves the control of five factors: lime content, moisture content, mixing, including depths, compaction, and curing.

The Technician can easily monitor the control of these factors by organizing the inspection steps into a routine that follows the sequence of construction operations.

The following checklist covers the inspection steps required to ensure quality lime-soil construction:

1. Have soil surveys, laboratory reports, plans, and specifications been reviewed and correlated with job conditions?
2. Have all soft subgrade areas been corrected? Has the roadway been shaped to crown and grade?
3. Have manhole covers and other obstacles been removed or lowered?
4. Is the Contractor aware that a period of 24 days between sampling and testing for final design of the lime stabilization is required?
5. Are weather conditions suitable for lime-soil construction?
6. Have the soil materials been pulverized sufficiently and will their moisture contents allow them to mix readily with lime?
7. Has the proper quantity of lime been spread uniformly?
8. Is the soil-lime mixture between optimum moisture and 3% above optimum moisture at time of primary mixing?
9. Is the mixture uniform and thoroughly mixed?
10. Is the finished surface moist, dense and free of compaction planes?
11. Is the soil-lime mixture at the transverse construction joint well mixed and compacted?
12. Is the soil-lime mixture between optimum moisture and 2% above optimum moisture during compaction operations?
13. Are the specified density and depth of treatment being achieved?
14. Is sufficient curing material for complete coverage being applied? Where subjected to traffic, has the bituminous material been sanded sufficiently to prevent pickup?
15. Is the curing period complete?
16. Is one of the approved curing seals being used and is the curing period complete?
17. Have all defects been repaired for the full depth of treatment?

Example Given: Recommended rate - 2.34 lb/sf

Given: Recommended rate = 2.34 lb/sf

Road width = 34.12 ft

L = "Pull Length"

Truckload Weight = 45,000 lb.

Solution: Rate x area = load weight

Determine amount for unit length (1 foot)

(rate) (area) (weight)

$$2.34 \text{ lb/sf} \times (34.12 \text{ ft} \times 1 \text{ ft}) = 79.84 \text{ lb per foot}$$

$$\text{"pull length" (L)} = \frac{\text{Truckload weight}}{\text{weight/ foot}} = \frac{45,000 \text{ lb.}}{79.84 \text{ lb. / ft.}} = 563.63 \text{ ft.}$$

When using lime in slurry form, it is necessary to convert the weight of quicklime to weight of hydrated lime. This conversion is based on the slaking chemistry using the relative molecular weights.

This information is contained on the lime slaking batch report which is furnished by the supplier and should accompany the shipping ticket.

**** conversion factor from quicklime to lime slurry**

	(shipping weight)	(% purity)	(conversion factor)	
A. quicklime delivered =	23.12 tons	X 97.72%	X 1.32	= 29.82 lbs.
B. quicklime delivered =	23.12 tons	X 2.28%		= 0.53 lbs.
Total hydrated lime produces				⇒ 30.35 lbs.

* use this amount for pay quantity and to calculate the length of pull

Given: Truckload weight = 30.35 tons (lime slurry)

Road width = 34 ft. (1 ft. outside pavement structure)

Recommended rate = 21 lbs/sy (3 1/2" for 8" depth)

Solution: Rate x area = load weight

Determine amount for unit length (1 ft.)

$$21 \text{ lb/sy} \times \frac{(34 \text{ ft.} \times 1 \text{ ft.})}{9 \text{ ft}^2/\text{sy}} = 79.33 \text{ lbs. per linear ft. of roadway}$$

$$\text{Truckload weight} = 30.35 \text{ tons or } 30.35 \times 2000 \text{ lbs/ton} = 60,700 \text{ lbs.}$$

$$\text{"Pull length" (L)} = \frac{(\text{Truckload weight}) 60,700}{(\text{weight/linear ft.}) 79.33} = 765 \text{ ft.}$$

SECTION 505 AGGREGATE SUBGRADE

505-1 DESCRIPTION

The work covered by this section is the construction of a subgrade from an inferior quality earth material by adding and mixing a controlled amount of graded aggregate to give the earth material greater stability before compaction is attempted. Aggregate stabilized areas are not considered as part of the "pavement structure," which is to say, they have no bearing on the total thickness of base and pavement required to transfer the traffic load. Aggregate stabilization is not a substitute for other forms of soil stabilization. The sole purpose of aggregate stabilization is to provide a stable working platform for base course operations. Aggregate stabilization is used to prevent horizontal and vertical displacement of the existing earth material.

505-3 CONSTRUCTION METHODS

There will be instances when the plans indicate a range of aggregate stabilization to be utilized in areas directed by the Engineer. There will be other instances when no aggregate stabilization is provided for in the contract and during the course of the work, it will be determined that a portion or all of the subgrade needs stabilization. In these instances, it is absolutely necessary that project personnel "look ahead" and promptly make decisions relative to the need for stabilization before the Contractor begins his fine grade operations. Wherever possible, this decision should be made by project personnel. However, assistance may be obtained from the Engineer or the Geopavement Section.

505-4 MEASUREMENT AND PAYMENT

There will be no compensation for the material excavated from the subgrade to accommodate aggregate stabilization.

TECHNICIAN'S CHECKLIST SECTION 505 AGGREGATE SUBGRADE

1. Study Specifications, plans, and Special Provisions.
2. When sampling at the road is performed, ensure that samples are properly taken and testing expedited. Immediately inform the Contractor of any corrective action necessary.
3. If aggregates are from an approved stockpile, observe the loading, handling, and spreading for segregation.
4. Do not direct the amount of subgrade material removed, but check results and require adjustment until the finished subgrade is within Specification tolerance.
5. Observe mixing operations and check depth to see that aggregate is uniformly mixed with the soil to the required depth. Advise Contractor when depth is too little or too great or mixture is not uniform and request corrective action as necessary.
6. Run density tests as required.
7. Check aggregate application rates for compliance and record results in the project diary.

8. Do not permit excessive amounts of vehicle traffic over unmixed aggregate spread on the road resulting in loss or degradation of the aggregate. Hauling over completed sections could result in rupture and displacement and should not be permitted without advising the Contractor in writing that material and work required for repair will be at no cost to the Department.
9. Document all conversations and work performed in the project diary.

SECTION 510 AGGREGATE STABILIZATION

510-1 DESCRIPTION

The work covered by this section is the construction of a subgrade from an inferior quality earth material by adding and mixing a controlled amount of graded aggregate to give the earth material greater stability before compaction is attempted. Aggregate stabilized areas are not considered as part of the “pavement structure,” which is to say, they have no bearing on the total thickness of base and pavement required to transfer the traffic load. Aggregate stabilization is not a substitute for other forms of soil stabilization. The sole purpose of aggregate stabilization is to provide a stable working platform for base course operations. Aggregate stabilization is used to prevent horizontal and vertical displacement of the existing earth material.

510-3 CONSTRUCTION METHODS

There will be instances when the plans indicate a range of aggregate stabilization to be utilized in areas directed by the Engineer. There will be other instances when no aggregate stabilization is provided for in the contract and during the course of the work, it will be determined that a portion or all of the subgrade needs stabilization. In these instances, it is absolutely necessary that project personnel “look ahead” and promptly make decisions relative to the need for stabilization before the Contractor begins his fine grade operations. Wherever possible, this decision should be made by project personnel. However, assistance may be obtained from the Engineer or the Geopavement Section.

(A) MIXING

The roadbed should be graded to accommodate the stabilizer aggregate. The amount of such grade adjustment is dependent upon the type of material involved and is generally established by trial. The Engineer should, therefore, permit the Contractor to leave the graded surface low to the extent that he considers reasonable based upon his knowledge of the material but should in no way assume the responsibility for the conformity of the completed stabilized subgrade to plan grade and typical section requirements.

The Resident Engineer does have the authority to make minor grade adjustments where the subgrade is to be stabilized. These grade adjustments are limited to areas that do not involve structures requiring vertical clearance and intersection areas with critical grades, and should never be made unless a minimum of 200 feet can be utilized to make the transition to the new grade at each end of the adjustment. Grade adjustments of the above nature should be limited to the range of 0.1 foot or less and must be documented, recorded, and communicated to personnel responsible for base course and/or paving operations.

Since the grade tolerance for stabilized subgrade is the same as that for subgrade, the Contractor should be required to demonstrate that he is able to produce work within these limits before any appreciable amount of finished work has been produced. The Contractor is responsible for the determination of how much earth material to remove to provide for swelling.

When the plans indicate a range of application rates the Engineer should designate the required rate on any particular section. The aggregate material should always be spread with a mechanical spreader except where restrictive widths are to be treated or emergency type situations occur. Mixing must be uniform in order to obtain the desired stabilizing results. A soil pulverizing machine, such as a rotary mixer, is desirable and highly recommended. Small areas can be mixed by use of motor graders and disk or tiller type plows. Again, the Technician should closely observe the results obtained by the Contractor's methods and assure himself that the aggregate is being uniformly mixed to the required depth and width. The Specifications require mixing the aggregate with the top 3" of subgrade soil. Over-depth mixing is very undesirable in that additional aggregate may be required to obtain the required stability. The Technician should make sufficient checks to ensure that adequate mixing depth is being maintained.

510-4 TOLERANCE

The established grade is the finished subgrade elevation as set by the Engineer. A tolerance of plus or minus $\frac{1}{2}$ inch of this elevation is allowed. **Moreover, the maximum difference between the established grade and the stabilized subgrade within any 100 foot distance is $\frac{1}{2}$ inch.**

Refer to Article 500-3 of this manual for examples to clarify this tolerance.

510-6 MEASUREMENT AND PAYMENT

There will be no compensation for the material excavated from the subgrade to accommodate aggregate stabilization.

TECHNICIAN'S CHECKLIST
SECTION 510
AGGREGATE STABILIZATION

1. Study Specifications, plans, and Special Provisions.
2. When sampling at the road is performed, ensure that samples are properly taken and testing expedited. Immediately inform the Contractor of any corrective action necessary.
3. If aggregates are from an approved stockpile, observe the loading, handling, and spreading for segregation.
4. Do not direct the amount of subgrade material removed, but check results and require adjustment until the finished subgrade is within Specification tolerance.
5. Observe mixing operations and check depth to see that aggregate is uniformly mixed with the soil to the required depth. Advise Contractor when depth is too little or too great or mixture is not uniform and request corrective action as necessary.
6. Run density tests as required.
7. Check aggregate application rates for compliance and record results in the project diary.
8. Do not permit excessive amounts of vehicle traffic over unmixed aggregate spread on the road resulting in loss or degradation of the aggregate. Hauling over completed sections could result in rupture and displacement and should not be permitted without advising the Contractor in writing that material and work required for repair will be at no cost to the Department.
9. Document all conversations and work performed in the project diary.

SECTION 520 AGGREGATE BASE COURSE

520-5 HAULING AND PLACING AGGREGATE BASE MATERIAL

The Contractor's operations of loading, hauling, and placing the aggregate on the road should be continually observed and the Contractor's attention called to any methods which result in segregation or degradation of the material. Mechanical spreading equipment is required by the Specifications to ensure uniform depth and to minimize segregation. In small inaccessible areas or under emergency conditions the Engineer may permit placement without the use of a spreader.

It is the Contractor's responsibility to obtain the required rate of spread. The Technician is to check the rate as often as necessary to see that the thickness meets Specification requirements. The Engineer can obtain the specific gravity of the material being used from the Materials and Tests Unit or by sending a sample to the Materials & Tests Unit and requesting the weight per cubic foot. The rate of spread may be calculated by using the following formulas:

$$\text{Tons} = \frac{(W) (D) (L) (UW)}{2000}$$

Where: W = width of spread in feet
D = compacted depth in feet
L = distance in feet desired for a particular rate
UW = compacted unit wet weight in lbs/ft³

Given: Width = 12 feet
Depth = 8 inches = 0.67 feet
UW = 150 lbs/ft³
L = 100 feet

$$\text{Solution: Tons} = \frac{(12 \text{ ft}) (.67 \text{ ft}) (100 \text{ ft}) (150 \text{ lb. / ft}^3)}{2000 \text{ ton}}$$

$$\therefore \text{Tons} = 60.3 \text{ tons}$$

Since this is a theoretical rate and may not produce the required thickness, a close check of the spread should be made. In order to do this, the Contractor must shape and compact a section so checks can be run. This should be done early in the operations before the Contractor proceeds too far at an insufficient rate.

The Contractor is permitted to use more than one type of aggregate on the same project subject to the approval of the Engineer. This shall be restricted to the extent that such use will be done in a manner that permits any necessary sampling and testing. Aggregate materials with different specific gravities shall never be placed such that the different materials will be intermixed as this will result in erroneous density test results.

The Specifications are specific relative to layer thickness permitted. No deviation may be allowed without specific approval from the State Pavement Management Engineer.

The Specifications require that each layer be sampled, tested, compacted and approved prior to the placement of an additional layer or any pavement. Base course that is in place on November 15 shall be immediately covered with a subsequent layer of pavement structure or with a sand seal. The Specifications also require that any aggregate base course (ABC) placed between November 16 and March 15 inclusive must be **covered within 7 calendar days with a subsequent layer of pavement structure or a sand seal**. The Specifications allow the hauling, with permission of the Engineer, of material over the lower layers of ABC. Should the Contractor elect to haul, the costs of any repairs necessary to correct damage to these layers will be that of the Contractor. It is the intent of the Specifications that the through-hauling of materials over the completed final layer of base course is prohibited.

520-6 SAMPLING, TESTING, AND ACCEPTANCE

For sampling and acceptance purposes, a lot will be considered 2,500 tons or a fraction thereof. For each lot of aggregate, one sample shall be taken at a random location from the roadway. A minimum of three samples should be taken per project and no more than five days of placement shall occur without a sample. Refer to Division 10 of this manual for additional information regarding sampling and testing. See article 1010-2(C) for acceptability requirements.

The latest version of the "ABC Sampling Manual" provides details regarding the most recently approved sampling procedures. This manual requires the use of an ABC Sample Book for Roadway Assurance Samples. Refer to the "ABC Sampling Manual" located on the Materials and Tests Unit website for details. The website is located at the following address: <https://connect.ncdot.gov/resources/Materials/MaterialsResources/ABC%20sampling%20manual.pdf>. An example page and blank page for the ABC Sample Book are in the Records and Reports Section of this Manual under Forms and Examples.

520-7 SHAPING AND COMPACTION

Article 520-7 of the Specifications requires that shaping and compaction operations be performed within 48 hours following the placing operation in order to protect the subgrade from adverse weather conditions. If this procedure is not followed and the subgrade becomes excessively wet, the base course must be removed and the subgrade reworked. No payment shall be made for reworking the subgrade and/or removal and replacement of base course material.

The Contractor may utilize any type of rolling equipment which he deems most efficient in compacting the aggregate base and which does not excessively degrade the aggregates or rupture the subgrade. Accomplish compaction by the use of approved self propelled rollers except do not use a sheepfoot roller for more than two passes.

Compaction of aggregate base material should be accomplished when the moisture content is uniform and is at or near optimum moisture for the material. Normally, best results are obtained by adding adequate moisture to bring the moisture content to just above optimum and then letting the material dry during compaction. Experience has taught that moisture contents above optimum visually appear very wet, thus inexperienced Contractors are reluctant to apply sufficient water. Compaction when the aggregate is too dry or the application of too much compactive effort utilizing steel wheel rollers will almost certainly result in degradation of the

aggregate and should not be permitted. The base material should be scarified full depth prior to adding water to allow uniform distribution.

When a base has been shaped and the required density obtained, no further testing is required unless the Engineer has reason to believe that the stability has been lost. If rain is received on a prepared base, the Engineer should use his judgment as to whether or not proof rolling should be performed with a loaded water truck or a loaded triaxle dump truck. It may be very beneficial to proof roll the area in question to ensure stability prior to the paving operation.

When the surface of the base is found to be low during finishing and a small amount of aggregate material must be added (this is usually referred to as spotting), the existing base surface must be broken up by scarifying or other means in order to ensure that the added material is bonded and does not form scabs on the base surface.

The surface of the final layer of the aggregate base must not show an excessive amount of fine, slick-appearing material as this condition may result in future pavement failures. The use of a drag broom in connection with final finishing will provide a surface which will readily accept asphalt prime coat when required.

The use of an automatically controlled fine grade machine is required when so stated in the Special Provisions or where concrete pavement is to be placed. The Contractor may also elect to use this type of equipment when it is not a contract requirement. Any section should have the required density before fine grading. Since cutting the grade loosens a small depth of the base, it is also necessary that the fine grade machine be followed with a wetting and rolling operation that will consolidate this loose material. This may be checked by visual observation; however, in case of dispute, density tests may be required. It will be necessary to leave the compacted base approximately $\frac{1}{2}$ inch high ahead of the machine due to the fact that this equipment generally must be cutting the surface when in operation.

Excessive waste should be utilized by scattering ahead of the stone placing operation, placed within the spreader box, stockpiled or removed from the project. In all cases the gradation requirements must be maintained. If removed from the project, the quantity should be deducted from the original quantity provided. Control of the depth of stone during placement is the key to eliminating excessive clipping and waste. Excessive waste indicates that too much base material has been placed and base thickness is excessive or the subgrade has been improperly prepared. Waste can be reduced by observing the width of the mat, monitoring the effect shaping and compacting have on the mat width, and adjusting the width to maintain the required typical section. Preceding operations should be checked to eliminate this condition. If it is determined that the subgrade has been improperly prepared, the section should be repaired in accordance with Article 105-11 of the Specifications and this Manual.

520-8 TOLERANCES

A thickness tolerance of plus or minus $\frac{1}{2}$ inch of the base thickness required by the plans is allowed. The thickness of the base course may be checked either by cores, by digging through the base course and measuring depth or by recording the surface elevation by string line, bluetops, or levels taken at the same location and interval as were used in recording the surface of the subgrade. Base course under concrete pavement shall have a tolerance of plus or minus $\frac{1}{4}$ inch.

The maximum differential between the established grade and the base within any 100 linear foot section shall be $\frac{1}{2}$ inch or $\frac{1}{4}$ inch when used as a base course under concrete pavement.

520-9 DENSITY DETERMINATION BY NUCLEAR METHODS

(A) APPLICATION

A certified nuclear gauge Technician shall perform testing of the aggregate base course. Testing procedures are provided in the North Carolina Department of Transportation Nuclear Gauge Operator's Manual.

The unit weight should be obtained from the most recent AASHTO T180 test results, which are obtained from the Soils Lab within the Materials and Tests Unit or from the following website: <https://apps.dot.state.nc.us/quickfind/mtunitweight/>. A new unit weight should be obtained for each source of material, when a significant change occurs in the composition of the material or when deemed necessary. Materials and Tests should be contacted periodically to confirm that the unit weight is current and has not been revised.

520-10 MAINTENANCE

Continuous maintenance of surface drainage is an absolute necessity in order to avoid soft areas that may develop due to the base holding water for long periods of time. This requires the Technician to be on the alert for stopped-up drainage and depressed areas in the grade. These conditions should be immediately brought to the attention of the Contractor's Superintendent and corrected.

Maintenance of the base also requires the exclusion of hauling equipment, which causes rutting, weaving, or other distortion of the grade. Careful attention should be given to windrowed material on shoulders to assure that drainage outlets are provided through the windrowed material so as not to hold water, especially in vertical sags and the low side of superelevated curves.

520-11 MEASUREMENT AND PAYMENT

The Engineer is responsible for verifying that weighing equipment is approved by the Materials and Tests Unit prior to use, scales are checked, and weight tickets are prepared in accordance with Article 106-7 with the Records and Reports Section of this Manual.

When the gradation test results indicate a lot is outside Specification requirements, the provisions as detailed in Section 1010 shall be followed. **Base course material represented by this lot shall not be covered with subsequent layers of base, prime, or pavement until the material is re-sampled and a determination is made to correct, remove, or apply a price reduction per Article 105-3.** The Materials and Tests Unit should be involved in the re-sampling and determination process.

The Engineer should promptly notify the Contractor in writing of decisions related to failing lots.

When the Engineer receives a copy of a test report from the Materials & Tests Unit or other notification indicating a lot of aggregate base course is outside the limits of Column C or the range of Column D of Table 1010-1, the Engineer shall contact the Contractor and determine if he would like to request that a resample be taken. If the Contractor requests a resample, the Engineer shall contact the Soils Engineer of the Materials & Tests Unit. After reviewing the test results, the Soils Engineer of the Materials & Tests Unit will notify the appropriate Section Materials Specialist, who will be instructed to meet with the Engineer and arrange for the resample to be taken. The results of this resample will be considered as final and used as the basis of acceptance or rejection. The Materials & Tests Unit will advise the Engineer of the

results of the resample, and whether the lot can be corrected at the Contractor's expense by the addition of coarse or fine aggregate. The Contractor should be advised in writing of the final test results and whether correction is possible. The decision to correct or to remove and replace should be that of the Contractor, but the method of correction must be approved by the Roadway Construction Engineer. If no correction is possible or samples taken after the material has been corrected show the material to be outside the limits of Column B or the range of Column D of Table 1010-1, the Contractor should be advised to remove the material from the project. No subsequent courses or pavements should be placed on the subject lot of material until a final decision is made and agreed to by all concerned.

If the Aggregate Producer's Quality Control Samples show the material to be outside the limits of Column B or the range of Column D of Table 1010-1, the Aggregate Producer will notify the Quality Assurance Engineer of the automatic price reduction. The Quality Assurance Engineer will notify the Engineer of the price reduction and will provide the Engineer with copies of the Producer's test reports and calculations. The Engineer will notify the Contractor of the price reduction and will adjust the contract price for the material received.

An example of the price reduction calculation is as follows:

Test Results for Lot Number 1					% Outside Tolerance of Column C	% Outside Range of Column D	Points Using Column E
Sieve Size	A	B	Avg.	Difference			
37.5mm (1 1/2")	96	100	98	-4	0	1	1 x 1 = 1
25 mm (1")	92	95	94	-3	0	0	0
12.5 mm (1/2")	56	78	67	-22	0	2	2 x 1 = 2
4.75 mm (#4)	51	64	58	-13	0	0	0
2.00 mm (#10)	43	49	46	-6	0	0	0
0.425 mm (#40)	26	34	30	-8	0	0	0
0.075 mm (#200)	4	12	8	-8	0	1	1 x 5 = 5
(Soil Mortar)							
0.425 mm (#40)	60	73	67	-13	0	0	0
0.075 mm (#200)	28	34	31	-6	0	0	0
Total Points							8

Percent Adjustment = 8 Points x 2% = 16%

Contract Unit Price = \$15.00 Per Ton

Reduced Payment = \$15.00 x (100-16)%

Reduced Payment = \$15.00 x 84%

Reduced Payment = \$ 12.60 Per Ton

TECHNICIAN'S CHECKLIST
SECTION 520
AGGREGATE BASE COURSE

1. Study Specifications, plans, and Special Provisions.
2. Check subgrade for line, grade, cross sections, and compaction before placing base.
3. Record any corrective actions necessary in the subgrade, including work and/or materials removed and replaced.
4. Be certain that scales for weighting aggregate have been certified by the North Carolina Department of Agriculture.
5. Be familiar with sampling required and testing methods. Both sampling and testing shall be performed by a certified Technician.
6. Make sure that load tickets are issued, received and processed in accordance with the Records and Reports Section of the Construction Manual.
7. Check yield of material in each course.
8. Check loading, hauling, and spreading methods for segregation.
9. Ensure that machining and compaction are immediately begun following placement.
10. Perform compaction tests as required.
11. Check layer thickness after compaction to determine compliance with plan depths.
12. Check surface of final layers for conformity to line, grade and typical section, and record results.
13. Record conversations, observations, spot checks made, and work performed (total tonnage placed and area covered) in diary.
14. Record samples with location and test results in field notebook.

SECTION 530 was removed from the 2012 Specification Book but a Special Provision for Soil Type Base Course is available.

SECTION 535 CONDITIONING EXISTING BASE

535-1 DESCRIPTION

This section of the Specifications is intended for use when the Department elects to place base course materials with Department forces or by others and then let the preparation of base course and paving to contract. The work let to contract may or may not include addition of base course materials to the existing base.

535-2 CONSTRUCTION REQUIREMENTS

Since lines, grades, and typical sections usually are not previously established for work of this nature, the shaping on the existing base is done by “visual” methods. The base should be reasonably uniform in riding quality and cross-section when compaction is begun.

If the contract requires the addition of material, the Engineer should core the base for depth on roughly 200 foot intervals and record this information for use in adding material to obtain the required depth. The added material should be thoroughly bonded to the existing base by scarifying the existing base surface prior to placing the additional material.

If the contract does not require the addition of material, the Engineer should still perform enough depth checks to assure himself that the existing base depth is reasonably adequate.

The Engineer should also check the width of the existing base to determine if it is adequate and to establish alignment for pavement. Since it is unreasonable to attempt to run compaction tests on material which may have been obtained from an unknown source or more than one source, the required compaction is “to a degree satisfactory to the Engineer.” Observation of equipment operating on the base, riding over the base, and visual observation should be sufficient to verify that compaction is reasonably uniform and acceptable.

If areas of soft subgrade are observed, the Engineer should investigate these areas and determine whether they are due to natural causes or due to negligence on the part of the Contractor. Corrective action should be performed by Department forces or by the Contractor. The Contractor is not responsible for the subgrade except through negligence on his part in protecting the subgrade or damage due to acts of the Contractor. All repairs, excluding those necessitated due to negligence, shall be compensated in accordance with Section 104. Negligence, in the opinion of the Engineer, should always be discussed with the Division Engineer before any action is taken.

The requirements for maintenance of the base are those detailed in Article 520-10 or Article 530-11 of the Specifications, whichever is applicable.

TECHNICIAN'S CHECKLIST
SECTION 535
CONDITIONING EXISTING BASE

1. Study Specifications, plans, and Special Provisions.
2. If additional base material is to be added, core the existing base on intervals of approximately 200 feet and record results for use in placing additional material.
3. If additional material is required, scale certification tickets should be provided in accordance with Article 106-7.
4. Require the Contractor to add water or dry the existing material as required to obtain proper compaction. Scarify and shape the surface prior to beginning compaction.
5. Ride and visually observe the surface to provide acceptable ride quality.
6. Observe compaction and assure that results obtained are reasonably uniform and satisfactory. If yielding areas are observed, determine the cause.
7. See that the Contractor properly maintains the surface of completed sections until it is covered by pavement.

SECTION 540 CEMENT-TREATED BASE COURSE

540-1 DESCRIPTION

Cement treated base course is a mixture of aggregate material, Portland cement, and water that is mixed at a pugmill (Plant-mixed cement treated base course) or mixed on site on the road (Road-mixed cement treated base course).

540-3 LIMITATIONS

Since cement hydration practically ceases when temperatures are near or below freezing, cement treated base should not be placed when the temperature is below 40° F. In addition, it should be protected to prevent freezing for a period of seven days after placement. The seasonal limitations outlined in Article 540-3 of the Standard Specifications shall be strictly adhered to. Any deviations from these limitations will be approved only on a day-by-day basis by the Engineer.

The Engineer should monitor the Contractor's progress to ensure that all cement treated base is covered with a subsequent layer of pavement by December 1st of the same year. In the event the Contractor does not cover the cement treated base, a sand seal must be placed at the Contractor's expense. This seal does not relieve the Contractor from any damages that may result to the cement treated base.

540-4 PREPARATION OF SUBGRADE

Subgrade areas that are unstable must be corrected prior to placement of aggregate. If the subgrade is relatively dry, it should be moistened prior to placing aggregate.

540-5 CONSTRUCTION METHODS

(A) GENERAL- COMPOSITION OF MIXTURE

The source of aggregate must be documented by a current approved job mix formula. If there is no current approved job mix formula, the proposed aggregate source shall be sampled and the samples shall be submitted to the Department's Materials and Tests Unit at least three weeks prior to beginning production. Refer to Table 540-1 in the Standard Specifications for job mix formula tolerances.

(B) PLANT MIXED CEMENT TREATED BASE COURSE

(1) MIXING

(a) General

The cement, aggregates, and water must be thoroughly mixed in an approved central mixing plant. The Geopavement Section should be contacted for plant approval.

(b) Batch Type Plant

The batch weights of cement, aggregate, and water must be calculated according to the capacity of the plant.

(c) Continuous Flow Type Plant

It is very important that the plant be calibrated to make sure proper quantities of materials are entering the mixer and/or rotary-vane feeder. Each requires a surge tank or hopper for proper operation. The speed of the cement meter must be synchronized with the speed of the main feeder (aggregate) belt. Examples of the calibration calculations for a pugmill are shown at the end of this section.

(2) HAULING AND PLACING

Protective covers must be used on trucks hauling cement treated base to the roadway in order to avoid moisture loss. Time of loading to beginning of compaction is limited to **one hour**. The weigh ticket for each truck shall show the batch time. Place the cement treated base course on a moistened subgrade utilizing approved spreaders so that spreading progresses along the full width of the base in a uniform manner. If one spreader is not wide enough to cover the full width, then additional spreaders are required. Compact the base with approved equipment immediately following spreading to reduce moisture loss. A variety of compaction equipment may be required in order to achieve density. The Geopavement Section should be consulted for assistance with compaction issues.

(C) ROAD MIXED CEMENT TREATED BASE COURSE

(1) EQUIPMENT

All equipment to be used in the stabilization operation should be inspected and approved to be in good and safe working condition. The cement spreader must have an adjustable rate of flow and be capable of spreading the required amount of cement in one pass. All mixers shall be self-propelled and able to mix to a compacted depth of at least 10 inches. Equipment that leaks oil, grease, water or other materials may be removed from the job site unless repaired or replaced.

(2) SPREADING AND MIXING

The aggregate shall be placed on the prepared subgrade by means of mechanical spreading equipment to ensure uniform depth and to minimize segregation. The amount of aggregate placed prior to the applications of cement and mixing shall be that amount that can be processed within one week.

After the cement has been uniformly spread over the aggregate, the mixture shall then be thoroughly mixed with the use of a rotary mixer. The appropriate amount of water shall then be added. The mixing should continue until a uniform mixture is obtained. The moisture content at the time of final mixing and compaction shall be as required by Article 540-5(C)2.

540-6 COMPACTION

Moisture content of the cement treated base must be adequate to achieve compaction. Compaction must be expedited to avoid exceeding the three-hour time limit. **Spreading, compacting, and cutting grade to specified elevation is included in this three-hour time limit.**

540-7 CONSTRUCTION JOINTS

At the end of each day, a straight, transverse, vertical joint should be formed by cutting back into the completed work. In large or very wide areas, a similar longitudinal joint may be required. This procedure is typically performed with a motor grader. Attention should be given to forming a vertical face free of loose or shattered materials.

540-8 TOLERANCES

The thickness of the base shall be within a tolerance of plus or minus $\frac{1}{2}$ inch of the base thickness required by the plans. Base course under concrete pavement shall have a tolerance of plus or minus $\frac{1}{4}$ inch. The grade and thickness will be determined and **recorded** in a grade book by the Technician and should not vary more than $\frac{1}{2}$ inch per 100 feet, (e.g., if a location indicates an excess of $\frac{1}{2}$ inch of stone at one location and is shy $\frac{1}{2}$ inch of stone 100 ft away, then this section **meets the thickness tolerance** but **does not meet the grade tolerance** maximum of $\frac{1}{2}$ inch difference in the established grade within a 100 foot section). When used as a base course under concrete pavement, the grade tolerance shall be a maximum of $\frac{1}{4}$ inch difference in the established grade within a 100 ft section.

540-9 CURING

Curing of cement treated base utilizes membrane curing, which involves sealing the compacted layer with an asphalt curing seal. Careful attention should be given to the rate of application of curing seal to ensure that the layer is fully covered, but not to the extent that the asphalt runs off excessively. A 7-day curing is required. See Section 543 of this Manual for more information regarding the curing seal.

540-10 AGGREGATE FOR CEMENT TREATED BASE

Aggregate for cement treated base course may be obtained from previously approved stockpiles or from quarry production (see Articles 540-10 and 1010-4 of the Standard Specifications).

540-11 TRAFFIC

The stabilized area will be closed to all traffic during the curing period, except for local, lightweight traffic. Areas of roadway, which have to be utilized by local, lightweight traffic should be covered with sand at the rate of 10 pounds per square yard or other material that has been approved by the Engineer, refer to Section 818.

Construction equipment shall not use stabilized areas for haul roads, except to discharge material into a spreader during base construction or paving operations. **The heavy loads**

imposed by hauling and paving equipment may create a major problem in some stabilized layers. The wheel loads from this equipment will produce higher stresses in the stabilized soils than the stresses anticipated from traffic loads after the road is in service.

540-12 MAINTENANCE

The stabilized area shall be protected from freezing and maintained by the Contractor until it has been covered with a layer of pavement. Any maintenance or repair necessary will be performed by the Contractor at no cost to the Department and shall be repeated as often as may be necessary to keep the stabilized base in an acceptable condition until all work is completed and accepted.

540-13 MEASUREMENT AND PAYMENT

The quantity of base course to be paid for will be the number of tons satisfactorily incorporated into the CTBC and will be measured by weighing in trucks on certified platform scales or other certified weighing devices per Article 106-7. No deduction will be made for any moisture contained in the base mixture at the time of weighing. Measurement will not be made of any base mixture added or replaced for corrective measures during construction or for repairing damaged areas.

The quantity of Portland Cement to be paid for will be the number of tons of cement that has been incorporated into the mix (by weight ticket or theoretical). When bulk cement is used, the quantity will be measured by weighing in trucks on certified platform scales or other certified weighing devices per Article 106-7. Measurement will not be made of any cement added or replaced for corrective measures.

TECHNICIAN'S CHECKLIST
SECTION 540
PLANT-MIXED, CEMENT TREATED BASE COURSE

Field inspection of Cement Treated Base Course (CTBC) construction involves the control of 5 factors: cement content, moisture content, mixing, compaction, curing.

The Technician can easily monitor the control of these factors by organizing the inspection steps into a routine that fits in with the sequence of construction operations. The Geopavement Section may be consulted in the mixing and placement process.

The following checklist covers the inspection steps required to ensure quality CTBC:

1. Have laboratory reports, plans, and Specifications been reviewed and correlated with job conditions?
2. Have all soft subgrade areas been corrected? Has the roadway been shaped? Have manhole covers and other obstacles been removed or lowered?
3. Is all of the construction equipment properly adjusted and in good working condition?
4. For plant-mixed CTBC, is the central mixing plant properly equipped with metering devices to control rates of flow (continuous-flow type pugmill)?
5. For plant-mixed CTBC, has the central mixing plant been properly calibrated?
6. A ½ gallon sample of cement should be obtained at a minimum frequency of one (1) sample per day provided the cement placed that day is from the same lot. The sample must be obtained from the discharge line.
7. Is the CTBC mixture between optimum moisture and 1.5% above optimum moisture?
8. Is the mixture uniform and thoroughly mixed? Is the width and depth of treatment according to the plans?
9. Is the finished surface moist, dense, and free of compaction planes?
10. Is the CTBC mixture at the transverse construction joint well-mixed and compacted?
11. Is the specified density and depth of CTBC being achieved?
12. Is one of the approved curing seals being used and is sufficient curing material for complete coverage being applied? Where subjected to traffic, has the bituminous material been sanded sufficiently to prevent pickup?
13. Have all defects been repaired for full depth of treatment?
14. Record in field notebook station number, placement location, Sample Number and test results.

Example of Pugmill Calibration

Given: Rate of cement required = 3.5%

Optimum moisture = 5.3%

In-place moisture of Aggregate = 3.2%

One gallon of water = 8.33 lb. (1.5% tolerance)

Two one-minute runs of ABC = 10,400 lb. & 10,700 lb. = 10,550 lb. avg. weight/min.

Solution: 10,550 lb./min. divided by 1.032 = 10,223 lb./min. of dry Aggregate
10,223 lb./min. x 3.5% = 358 lb./min. cement divided by 4 to get weight per 15 seconds = 89.5 lb. cement per 15 seconds (89.5 lb. is an easier amount to weigh for calibration)

10,223 lb. dry Aggregate + 358 lb. cement = 10,581 total dry wt. of Aggregate and cement

10,581 lb. (weight of ABC and cement) x (.053 + .015 - .032) = 381 lb. water

381 lb. water x 1 gallon / 8.33lb. = 45.7 or 46 gallons of water per min.

1. 10,223 avg. lb. dry Aggregate per min.
2. 358 lb. cement per min.
3. 46 gallons of water per min.

Example: For figure “pull” or area to be covered by truckload of cement:

Given: Unit weight (ABC) = 140 lb./c.f.

Truckload weight (Cement) = 45,000 lb.

Road width = 34 ft. (1 ft. outside pavement = 24', 4', 4', 2')

Recommended rate = 29 lb. (4% for 7" depth)

Solution: Road width (34') divided by 9 = 3.78 sy per linear ft.

Rate (29 lb.) x sy (3.78) = 109.62 lb. per linear ft.

Truckload weight (45,000) divided by lb. per linear ft. (109.62) = 410.5 per linear ft.

SECTION 542 SOIL-CEMENT BASE

542-1 DESCRIPTION

Soil-cement is a mixture of pulverized soil material or aggregate (Std. size ABC) and measured amount of Portland Cement and water. As the cement hydrates, the mixture becomes a hard, durable base material.

Only three basic ingredients are needed for soil-cement: soil material, Portland Cement, and water. The soil in soil-cement can be a wide variety of materials. Either in-situ or borrow material can be used. Old granular-base roads with or without their asphalt surfaces can be recycled to make soil-cement.

The Geopavement Section should be consulted and involved in a pre-stabilization meeting with the Contractor and the Engineer's staff.

542-3 LIMITATIONS

Since cement hydrations practically cease when temperatures are near or below freezing, soil-cement construction should not be permitted when the temperature is below 40° F or when conditions indicate that the temperature may fall below 40° F within 24 hours. Calendar restrictions have been removed.

Soil-cement should be protected to prevent its freezing for a period of seven days after placement. Strictly adhere to the seasonal limitations. Any deviations from these limitations should be approved by the Engineer only on a day by day basis.

The Engineer should monitor the Contractor's progress to ensure that all cement-treated base is covered with a subsequent layer of pavement by December 1st of the same year. In the event the Contractor does not cover the soil-cement base, a sand seal must be placed at the Contractor's expense. This seal does not relieve the Contractor of any responsibility for damage to the soil-cement base.

542-4 EQUIPMENT

(A) GENERAL

The Engineer should inspect and approve all equipment to be used in the soil-cement base operation before the Contractor begins construction. **All safety measures should be in place and operating prior to use.**

(B) CEMENT SPREADERS

A mechanical spreader shall be used that has an adjustable rate of flow and the capability of spreading the required amount of cement in one pass. If the Contractor experiences difficulty in spreading the required amount of cement in one pass, the tanker truck may be towed with a slower-moving piece of equipment. It is very important for the cement to be spread uniformly in order to achieve the required rate and desired strength.

(C) WATER DISTRIBUTION EQUIPMENT

Water is generally distributed by a tanker truck equipped with a pressure distributor or other suitable equipment that can uniformly spread water. Tanker trucks should be free of fuel and water leaks to prevent creating saturated areas.

(D) MIXERS

Two mixers are needed for good production. It is desirable that one of these be equipped with spray bars and water tanker hookup for adding water to the soil-cement mixture.

(E) COMPACTION EQUIPMENT

A sheepsfoot or other comparable equipment should be used for obtaining full-depth compaction; however, final rolling of the completed surface will be done with a pneumatic tire roller or if permitted by the Engineer, a steel wheel roller. All compaction equipment shall be self-propelled.

(F) SCARIFYING EQUIPMENT

Approved equipment typically consists of a motor grader equipped with scarifying teeth able to partially pulverize soil to a depth of 4 to 10 inches.

542-5 PREPARATION OF ROADBED

Areas that are exceptionally unstable as compared to the prevailing project conditions must be corrected before stabilization starts. When deep unstable areas are encountered, it is usually necessary to remove the underlying soil by undercutting and replacing it with better material.

The grade at the start of construction will influence the final cross section. Before any processing is started, the roadway should be shaped to approximate section and grade. Maintenance of the proper section will permit rapid run-off of water during heavy rains and aid in preventing wet spots.

542-6 SCARIFYING

The soil in the area to be stabilized shall be scarified to the required depth and width prior to application of cement. This reduces the displacement of cement when the mixer passes through the cement during mixing.

542-7 APPLICATION OF CEMENT

1. Cement should not be spread under windy conditions.
2. The cement should be mixed into the soil soon after spreading.
3. Cement should not be spread on excessively wet soil.
4. Moisture content of the soil should not exceed optimum moisture and should be checked in advance of cement spreading.

5. All operations must be completed during daylight hours in the same day of spreading cement, except as otherwise permitted in the Special Provisions or the Traffic Control Plans.
6. Time is very important in soil-cement work. No more than 4 hours should elapse between adding water and completion of finishing.

542-8 MIXING

1. A thorough mixture of the pulverized soil material, cement, and water must be obtained.
2. Uniformity of the mix is easily checked by digging trenches or a series of holes at regular intervals for the full depth of treatment and inspecting the color of the exposed mixture.
3. Proper moisture is very important during mixing and must be followed closely during the entire operation.
4. Close attention must be given to avoiding wet spots or streaks.
5. In order to avoid setting, remix any soil and cement mixture that has not been compacted and finished within 30 minutes.

542-9 COMPACTION

Begin compaction immediately after the mixing operation is complete. Proper moisture content is important during compaction. The density value should be based on a representative field sample of the soil-cement mixture, not on the untreated (raw) soil. A pneumatic roller of sufficient weight to compact the entire layer in one lift shall be used. Lightweight equipment may tend to compact the top of the layer that will bridge the lower part and not obtain full compaction throughout the layer. The mixture shall be compacted to at least 97% of that obtained by a moisture-density test using ASSHTO T134 as modified by the Department.

542-10 FINISHING

1. The moisture content shall be maintained at not less than optimum during finishing operation.
2. If the finished grade is found to be low, the area should be scarified, and treated material added and recompactd. This helps prevent compaction slippage planes.
3. Compaction shall then be continued until uniform and adequate density is obtained.
4. When rain causes excessive moisture, the entire area shall be reconstructed at no cost to the Department.

542-11 THICKNESS

The Technician should determine and record in the daily diary the thickness of the soil cement by digging test holes at random intervals, not to exceed 500 feet. To ensure that final compacted depths are correct, the depths should be checked utilizing the string line from hub to hub during final mixing. The measured thickness shall be no greater than plus 1 inch or minus ½ inch of the thickness established on the plans or as otherwise directed. A noticeable change in color and/or texture can be observed between treated and non-treated soil. If the soil-cement thickness is not within the above described limits, remove and replace at no cost to the Department.

542-12 CURING

Curing of soil-cement utilizes **membrane curing**, which involves sealing the compacted layer with an asphalt curing seal. Particular attention should be given to the rate of application to ensure that the layer is fully covered, but not to the extent that the asphalt runs off excessively. A 7-day curing is required. In lieu of membrane curing, the Engineer may permit the placement of Aggregate Base Course if placed within 24 hours of finishing the soil-cement. The Engineer should consult with the Geopavement Section.

542-13 CONSTRUCTION JOINTS

At the end of each day, a straight, transverse, vertical joint will be formed by cutting back into the completed work. In large or very wide areas, a similar longitudinal joint may be required. This procedure is typically performed with a motor grader. Attention should be given to forming a vertical face free of loose or shattered materials.

542-14 TRAFFIC

The stabilized area will be closed to all traffic during the curing period except for local, lightweight traffic. Areas of roadway which have to be utilized by local lightweight traffic should be covered with sand at the rate of 10 pounds per square yard, or other material which has been approved by the Engineer.

Construction equipment shall not use stabilized areas for haul roads except to discharge material into the spreader during base construction or paving operations. The heavy loads imposed by hauling and paving equipment may create a major problem in some stabilized layers. The wheel loads from this equipment may produce higher stresses in the stabilized soils than the stresses to be anticipated from traffic loads after the road is in service.

542-15 MAINTENANCE

The stabilized area will be protected from freezing and maintained by the Contractor until it has been covered with a layer of pavement. Any maintenance or repair necessary will be performed by the Contractor at no cost to the Department and shall be repeated as often as may be necessary to keep the stabilized soil in an acceptable condition until all work is completed and accepted.

TECHNICIAN'S CHECKLIST
SECTION 542
SOIL-CEMENT BASE

Field inspection of soil-cement construction involves the control of five factors: cement content, moisture content, mixing, including depths, compaction, and curing.

The Technician can easily monitor the control of these factors by organizing the inspection steps into a routine that fits in with the sequence of construction operations. The Geopavement Section may be consulted to assist in the mixing and placement process.

The following checklist covers the inspection steps required to assure quality soil-cement:

1. Have soil surveys, laboratory reports, plans, and specifications been reviewed and correlated with job conditions?
2. Have all soft subgrade areas been corrected? Has the roadway been shaped? Have manhole covers and other obstacles been removed or lowered?
3. Is the Contractor aware that a period of 24 days between sampling and testing for final design of the cement stabilization is required?
4. Is all construction equipment properly adjusted and in good working condition?
5. Do all the weigh tickets for the cement have a certified N. C. weighmaster's stamp?
6. Have the soil materials been pulverized sufficiently and will their moisture content allow them to mix readily with cement?
7. A ½ gallon sample of cement should be obtained at a minimum frequency of one sample per day, provided the cement placed that day is from the same lot. The sample must be obtained from the discharge line, never from the ground after spreading.
8. Has the proper quantity of cement been spread uniformly?
9. Is the soil-cement mixture between optimum moisture and 2% above optimum moisture?
10. Is the mixture uniform and thoroughly mixed? Is the width and depth of treatment according to the plans?
11. Is the finished surface moist, dense and free of compaction planes?
12. Is the soil-cement mixture at the transverse construction joint well-mixed and compacted?
13. Is the specified density and depth of treatment being achieved?
14. Is one of the approved curing seals being used?
15. Is sufficient curing material for complete coverage being applied? Where subjected to traffic, has the bituminous material been sanded sufficiently to prevent pickup?
16. Have all defects within the completed soil-cement base been repaired for the full depth of treatment?

Example: To figure “pull” or area to be covered by truckload of cement:

Given: Truckload weight (Cement) = 45,000 lb.

Road width = 34 ft. (1 ft. outside pavement = 24' + 4' + 4' + 2')

Recommended rate = 29 lb. (4% for 7 inch treated depth)

Find: Area (or “Pull”) to be covered by a truckload of cement

Solution: Road width (34') divided by 9 sf / sy = 3.78 sy per linear ft.

Rate (29 lb. / sy) x (3.78 sy per linear foot) = 109.62 lb. per linear ft.

Truckload weight (45,000 lb.) divided by 109.62 lb. per linear ft. =
410.5 ft. pull length

SECTION 543 ASPHALT CURING SEAL

543-1 DESCRIPTION

An asphalt curing seal is a membrane curing method for chemically stabilized soils and bases. Where directed, blotting sand will be used to maintain traffic. Refer to Section 818 for Blotting Sand.

543-2 MATERIALS

A request may be received occasionally from a Contractor to use a curing seal material other than those listed. This request should be discussed with the Geopavement Section and Materials and Tests Unit to avoid improper seal material. It should be noted that the Geopavement Section only evaluates whether the proposed substitute seal will serve the intended purpose. Any reduction in unit price will be negotiated between the Engineer and the Contractor and approved by the State Construction Engineer.

543-3 EQUIPMENT

Prior to beginning operations, the Technician shall visually inspect all equipment to be used on the job. While it is not the responsibility of the Technician to direct the Contractor as to which equipment to utilize the Technician should see that each piece of equipment is operating properly. **Section 600-5** of this Manual gives a brief description of the operation of application equipment. If the equipment meets Specifications and is in satisfactory operating condition, a statement shall be entered in the Technician's Daily Diary. If it is not, the Contractor should be advised accordingly and corrective actions should be taken before work begins.

543-4 CONSTRUCTION METHODS

1. The established soil or base shall be kept moist until the curing seal is applied.
2. The asphalt curing seal shall be applied within 24 hours after completing the stabilization.
3. The Engineer shall direct the rate of application as required by specifications.
4. The stabilization shall be cured for seven days, at or above 50° F.
5. The Contractor must maintain the curing seal at no cost to the Department.
6. Blotting sand shall be used where necessary to maintain traffic.

543-5 MEASUREMENT AND PAYMENT

Measure prime coat and curing seal at the application temperature. The material shall be free of air bubbles and foam. The Specifications provide for a deduction in the gallons applied if the Contractor exceeds a directed rate by more than 0.02 gallons per square yard. Therefore, records must indicate the directed rate for each shot as well as the computed actual rate.

Example:

Given: Directed rate = 0.350
Actual rate applied = 0.405
Area of coverage = 2,493 sy

Solution: The actual rate applied is greater than the directed rate + 0.02.
 \therefore for payment purposes $0.350 \text{ gallons/sy} + 0.02 = .370 \text{ gallons/sy}$.
 $.370 \text{ gallons/sy} \times \text{the area of coverage} = .370 \text{ gallons/sy} \times 2,493 \text{ gallons} =$
922.41 gallons

This is the quantity to be paid for in this particular application. These calculations and rates will be listed with the individual shot records, so it is imperative that ample space be allowed in the pay record book between recorded shots.

TECHNICIAN'S CHECKLIST SECTION 543 ASPHALT CURING SEAL

1. Study Specifications, plans, and Special Provisions.
2. Ensure that the finished stabilized layer or base is kept continuously moist until the asphalt curing seal is placed.
3. Ensure that the asphalt curing seal is applied within 24 hours and at the manufacturer's recommended temperature after completing the stabilization.
4. Make sure that the curing seal was applied at the rate established by the Engineer.
5. Monitor the temperature to ensure the requirements for the seven-day curing are met.
6. Ensure that the Contractor protects areas to be crossed by traffic by using blotting sand.
7. Record in the diary all conversations, observations, spot checks made, and work performed.

SECTION 545 INCIDENTAL STONE BASE

545-1 DESCRIPTION

The inclusion of Incidental Stone Base in the Specifications is to eliminate the necessity for sampling and testing of relatively small amounts of aggregate base material that are not critical with respect to gradation and that will not be incorporated into the pavement structure.

The Engineer may direct the Contractor to maintain a stockpile of Incidental Stone Base for use during the life of the project.

545-3 GRADATION SAMPLING, TESTING, AND ACCEPTANCE

This article allows the use of judgment on the part of the Engineer. For acceptance of incidental stone base material, the Engineer should be guided by the material requirements shown in Article 545-2 of the Specifications and also by the location in which the material is to be used. For example: Aggregate used beneath island covers could obviously be finer graded than aggregates for driveways or temporary detours exposed to traffic.

545-4 PLACING AND SHAPING STONE

When supplementing existing stone on driveways, use a similar graded stone.

545-6 MEASUREMENT AND PAYMENT

Platform scales utilized in weighing material must be checked and certified by the N. C. Department of Agriculture (see Article 106-7 of this manual). Any other type of weighing equipment must be approved by the Materials & Tests Unit prior to use. The Engineer is responsible for seeing that scales are checked or weighing equipment is approved.

Weight tickets shall be prepared in accordance with the Records and Reports Section of this manual.

Payment is by the ton and includes, but is not limited to, furnishing, hauling, placing, shaping, tamping, maintaining the base, and disposing of surplus stockpiled material as needed. Payment is made for the actual number of tons which have been used on the project. Care should be taken when stockpiling material for anticipated use to avoid waste.

TECHNICIAN'S CHECKLIST
SECTION 545
INCIDENTAL STONE BASE

1. Weight tickets must be in accordance with the Records and Reports Section of this Manual.
2. This type of material is accepted based upon being “well graded from 1-1/2 inches through No.200 sieves” and “as being satisfactory for the purpose intended.” This is acceptance by visual means. If material furnished by the Contractor will obviously not serve the intended purpose, do not allow its use. If use is questionable, consult with Engineer prior to use.
3. Driveways, temporary detours, etc., on which Incidental Stone Base is placed, and which carry traffic, are to be maintained by the Contractor as required by traffic and weather conditions.
4. Care should be taken when stockpiling aggregate for anticipated use to avoid excess waste.

SECTION 560 SHOULDER CONSTRUCTION

560-1 DESCRIPTION

This section describes the construction of the portion of the roadway adjacent to the travel way for stopped vehicles, emergency use and lateral support of base and surface courses. Shoulder construction on previously graded roadway shall also include re-shaping and finishing of slopes adjacent to the shoulders and roadway ditches (see Section 500 of this Manual).

560-2 MATERIALS

Materials for shoulder construction shall be obtained from unclassified excavation, fine grading operations, or from borrow sources.

It should be noted that borrow material sources must be sampled prior to the use of the material. Material generated from fine grading operations used to construct the top 6 inches of shoulder and fill slopes should be sampled and tested to ensure conformance with Article 560-3.

560-3 CONSTRUCTION METHODS

Construct the top 6 inches of shoulders and fill slopes with soils capable of supporting vegetation. Provide soil with a P.I. greater than 6 and less than 25 and with a pH ranging from 5.5 to 6.8. Remove stones and other foreign material 2 inches or larger in diameter.

Construct shoulders early in the project so that vegetation can be established during the life of the project; however, ensure proper drainage of grade is maintained. The Specifications require that shoulders shall be constructed “in proper sequence with the type of base and pavement being constructed.” The Contractor should not be allowed to delay shoulder construction to the extent that damage due to water ponding, damage to exposed base course beneath the pavement, and similar conditions occur. The Engineer should notify the Contractor, in writing, of conditions which may result in damage, making reference to Section 107-18 of the Standard Specifications.

When placing shoulder material, allow for swelling due to seed bed preparation. Initial compaction of the surface, however, should be to a degree to effectively prevent erosion until such time as the seeding and mulching are performed. This is especially important in regards to concrete pavements because no final inch is placed after completion of the shoulder work. Should earth shoulder areas become eroded to any appreciable degree, the Contractor shall be required to reshape and recompact the shoulder section.

Damage to the pavement surface during the construction of earth shoulders is extremely difficult to repair and the decision to remove and replace damaged areas requires much consideration and good judgment. The Engineer and Technician should caution the Contractor and require the immediate removal of any equipment which is causing damage to the pavement (see Article 108-5 of this Manual). Equipment which exceeds legal highway load limits (see Article 105-15 of this Manual) should not be used by the Contractor in shoulder construction unless such equipment travels entirely on earth shoulders or other earth areas. Topsoil should have been stockpiled from the initial excavation process for reuse on shoulders.

560-4 MEASUREMENT AND PAYMENT

This article provides for the use of cross-sections or truck measurement, or both, in measuring material for earth shoulder construction. This is at the option of the Engineer if the Project Special Provisions do not dictate which method to use.

Suitable earth material excavated during the construction of the project may be utilized to construct the shoulders. Material resulting from fine grading, trenching out existing subgrade and/or shaping ditches (which can be used without requiring stockpiling) will **not** be paid for as “Shoulder Borrow” because this work is considered incidental. Material which is stockpiled during the grading of turnkey projects will not be paid for as shoulder borrow as the contractor constructing the base requiring fine grading had control of the initial grade. On base and pave projects, material which has been stockpiled and used to construct shoulders should be measured and paid for as “Shoulder Borrow”. No payment will be made for the removal and disposal of any surplus material remaining in the stockpiles after the shoulders have been completed (see Article 225-7 of the Specifications).

TECHNICIAN'S CHECKLIST SECTION 560 SHOULDER CONSTRUCTION

1. Study Specifications, plans, and Special Provisions.
2. Ensure that the correct quantity and quality of material are used to produce the correct typical section. (Make allowance for some swelling when plowing for seeding.)
3. Require the Contractor to perform shaping and compaction of shoulder material reasonably soon after the material has been placed.
4. Do not permit the use of equipment on the completed base or pavement which exceeds highway load limits or which damages the surface of the pavement.
5. Check conformity to typical section and require Contractor to correct any deficiency.
6. Record all conversations, observations, spot checks made, and work performed in the daily diary.